1226243

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DRAWINGS ATTACHED

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H2A 2CX

B3A 44

(54) IMPROVEMENTS RELATING TO ELECTRIC MOTORS AND GENERATORS AND THE MANUFACTURE THEREOF

(71) We, UNIVERSAL ELECTRIC COMPANY, a Corporation organised and existing under the laws of the State of Michigan, United States of America, of 300, East Main Street, Owosso, State of Michigan, 48867, United States of America, (assignee of ALFRED MASTRODONATO, Sr., KURT PORTER and ROBERT ROYAL RHOADS), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to electric motors and generators and more particularly to the construction of the frame or housing of an electric motor or generator.

In the construction of electric motors it is customary to provide a cylindrical steel shell which encloses the stator and also to provide substantially flat circular end members or closures which support the bearings of the motor and hold them in concentric relationship to the stator. It is customary to provide such end members with a precision machined male rabbet which nests into a female rabbet machined into the cylindrical shell, thus providing the necessary precision location of the bearing. Close tolerance is necessary to center the rotor into stator and to hold the end closures perpendicular to the shell. The end members are held in position on the shell by bolts which extend through both end members and the full length of the cylindrical shell.

The cylindrical shells are made by rolling a flat piece of sheet metal and welding the resulting seam together. Because of the nature of the process, it is impossible to assure that the ends of the cylinder so formed will be perpendicular to the cylindrical axis. In fact, the sheet metal may deviate as much as 1/64 of an inch from a single plane thus forming a mismatch at the circumferential meeting of the ends of the sheet metal. This resulting mismatch and non-perpendicularity can only be corrected by a costly machining operation.

There are several disadvantages to using bolts to hold the end members in place. First, because motors vary in length and because it is necessary to offer a large variety of bolt lengths for the motor for mounting purposes, an extremely large inventory of bolts must be maintained. Second, a hole must be provided in the stator for the bolt to pass through the stator. This creates an area of high reluctance to the passage of magnetic flux. This hole is also very difficult to keep free of integral insulation and varnish. Third, the bolt must be adequately insulated from the motor winding. This is done by either insulating the bolt, the minding, or by forming the winding such that there is an adequate air gap clearance to the bolt.

According to one aspect of the present invention, the frame of an electric motor or generator comprises a generally cylindrical shell adapted to encircle the stator of the motor or generator, and a pair of end members adapted to support the bearings of the motor or generator, said shell having radially extending circumferentially spaced portions defining radial abutment surfaces axially inwardly spaced from the ends of the shell, said end members having surfaces engaging said last mentioned radial abutment surfaces, said abutment surfaces on said shell being accurately positioned longitudinally of said shell relative to one another and relative to the axis of said shell, said shell having circumferentially spaced portions thereof deformed generally radially to engage the outer surfaces of the end members, and thereby retain said end members against axial movement relative to said shell.

According to another aspect of the present invention, a method of making a frame or housing for an electric motor or generator comprises forming a rectangular blank into a cylindrical open ended shell, forming radially extending circumferentially spaced abutment surfaces on said shell at points axially in-

wardly spaced from the edges of said shell and accurately positioned relative to on another in a direction longitudinally of the shell, forming radially extending counter-surfaces on end members adapted to support the bearings of the motor or generator, bringing the radially extending counter-surfaces of the end members into engagement with the radial abutment surfaces on the shell, and thereafter deforming portions of the edges of said shell radially inwardly against the outer surfaces of the end members.

The invention is further described, by way of example, with reference to the accompanying drawings; in which

Fig. 1 is a part sectional, side elevational view of an electric motor constructed in accordance with one embodiment of the invention;

Fig. 2 is an end view of the motor of Fig. 1;

Fig. 3 is a fragmentary sectional view on an enlarged scale taken along the lines 3—3 in Fig. 2;

Fig. 4 is a fragmentary exploded perspective view of a portion of the electric motor shown in Figs. 1 to 3;

Fig. 5 is a fragmentary perspective view of another portion of the electric motor prior to assembly;

Fig. 6 is a fragmentary perspective view showing a portion of the motor after assembly;

Fig. 7 is a fragmentary side elevational view of modified form of an electric motor;

Fig. 8 is a fragmentary sectional view on a larger scale taken along the line 8—8 in Fig. 7;

Fig. 9 is a fragmentary side elevational view of a further modified form of electric motor;

Fig. 10 is a fragmentary sectional view on a larger scale taken along the line 10—10 in Fig. 9;

Fig. 11 is an end view of a further modified form of electric motor;

Fig. 12 is a fragmentary plan view of a portion of the motor shown in Fig. 11;

Fig. 13 is a fragmentary sectional view on a larger scale taken along the line 13—13 in Fig. 11;

Fig. 14 is a fragmentary view taken along the line 14—14 in Fig. 11;

Fig. 15 is a fragmentary view on a larger scale taken along the line 15—15 in Fig. 11;

Fig. 16 is an end view of a further modified form of the invention;

Fig. 17 is a fragmentary view on a larger scale taken along the line 17—17 in Fig. 16;

Fig. 18 is a fragmentary sectional view on a larger scale taken along the line 18—18 in Fig. 16;

Fig. 19 is an end view of a further modified form of the invention; and

Fig. 20 is a fragmentary view on a larger scale taken along the line 20—20 in Fig. 19.

Referring to Fig. 1, electric motor 10 embodying the invention comprises a frame 11 in which a stator 12 is fixed and a rotor 13 on a shaft 14 which is rotatably supported by bearings 15. The frame 11 comprises a cylindrical shell 16 and end members 17 which support bearings 15.

The shell 16 is made from sheet metal that is formed into a cylinder from a rectangular blank and welded longitudinally at the abutting or overlapping edges of the blank.

After forming, the shell 16 is placed on an arbor to shape the shell so that its interior surface is accurately formed cylindrically to receive the stator 12. Each end member 17 is also made of sheet metal and may have embossed portions 18.

After the shell 16 is formed, circumferentially spaced notches 20 (Fig. 4) and slots 21 (Fig. 5) are accurately pierced in the shell in a single punching operation for each end or both ends at once so that the distance between the base of the notches 20 at opposite ends and the distance between the slots 21 at opposite ends are accurate longitudinally of the shell.

Each end member 17 is formed with radially outwardly extending portions 22 that engage the radial surfaces of the base of notches 20.

Since the base of each notch 20 is accurately positioned longitudinally of the shell, the end member is in turn located accurately axially with respect to the shell. The engagement of the portions 22 with the sides of the notch 20 prevents circumferential movement of the end member.

The segments 23 defined by the slots 21 are then bent intermediate their ends as at Figs. 2, 3 and 6 radially inwardly against the outer surface of the end member 17 to hold end members in position without the use of bolts, screws or other types of fasteners.

Since the end members 17 are accurately positioned circumferentially and axially with respect to the shells, the bearings supported thereby will also be accurately positioned so that the longitudinal axis of the rotor 13 may coincide with the longitudinal axis of the shell 16.

In the form of the invention shown in Figs. 7 and 8, each end of cylindrical shell 25 has circumferentially spaced struck out portions 26 extending radially inwardly to define accurately positioned edges or radial surfaces 27 against which the end members 28 abut. The distance between portions 26 longitudinally is accurately defined. The periphery of each end member 28 is circular and the shell 25 is formed with circumferentially

spaced slots 29, which are accurately located axially relative to one another as are the notches 21 in the previous form of the invention This defines segments 30 that are bent radially inwardly and down against the outer surface of the end members 28 to hold the end members in position in the manner of the previous form of the invention.

In the form of the invention shown in Figs. 9 and 10, shell 31 is formed with pairs of slots 32, 33, accurately positioned longitudinally relative to one another. In assembly the slots 32 define segments 34 that are bent radially inwardly to form radial surfaces against which end members 37 abut and openings 35 for receiving axial projections 36 on the end members 37 to thereby locate the end members 37 circumferentially. The slots 33 define segments 38 that bent radially against the outer surface of the end members 37 to hold the end member 37 in position as in the previous forms of the invention.

In the form of the invention shown in Figs. 11 to 15, the cylindrical shell 40 is formed with circumferentially spaced notches 41 defining radial surfaces for receiving radial projecting portions 42 of the end members 43 in a manner similar to the form of the invention shown in Figs. 1 to 6. However, in this form of the invention, the portions 44 of the shell intermediate the notches 41 are bent radially inwardly over the edges of the end members 43 to hold the end members 43 in position (Figs. 11, 13, and 15).

In the form of the invention shown in Figs. 16 to 18, the cylindrical shell 50 is formed with notches 51 defining radial surfaces into which radially extending portions 52a of the end members 53 extend as in the forms of the invention shown in Figs. 1 to 6 and 11 to 15. However, in this form, the portions 52 of the end of the shell adjacent the sides of the notches 51 are separated by slots 53 from the remainder of the periphery and bent inwardly (Fig. 18) against the outer surface of the end members 53.

In the form of the invention shown in Figs. 19 and 20, cylindrical shell 55 has circumferentially spaced notches 56 defining radial surfaces against which radial portions 57 of the end member 58 abut as in the forms of the invention shown in Figs 1 to 6, 11 to 15 and 16 to 18. Other portions of the periphery of the shell 55 have circumferentially spaced slits 59 which define separated oppositely directed segments 60 that are bent inwardly against the outer surface of the end member 58.

In each of the described embodiments of the invention, the end members are located axially by surfaces formed in the shell which surfaces are spaced from the outer edges of the shell that may not be accurate after the forming operation. In this manner, and inaccuracy of the outer edges does not affect the location of the end members.

WHAT WE CLAIM IS:—

1. An electric motor or generator whose frame comprises a generally cylindrical shell adapted to encircle the stator of the motor or generator, and a pair of end members adapted to support the bearings of the motor or generator, said shell having radially extending circumferentially spaced portions defining radial abutment surfaces axially inwardly spaced from the ends of the shell, said end members having surfaces engaging said last mentioned radial abutment surfaces, said abutment surfaces on said shell being accurately positioned longitudinally of said shell relative to one another and relative to the axis of said shell, said shell having circumferentially spaced portions thereof deformed generally radially to engage the outer surfaces of the end members, and thereby retain said end members against axial movement relative to said shell.

2. An electric motor or generator as claimed in claim 1 in which said radially deformed portions are deformed radially inwardly to engage the outer surfaces of said end members.

3. An electric motor or generator as claimed in claim 2 wherein said radially deformed portions of said shell comprise circumferential segments which are bent from the shell.

4. An electric motor or generator as claimed in claim 3 wherein said radially deformed portions of said shell are disposed circumferentially between said radial abutment surfaces.

5. An electric motor or generator as claimed in claim 2 wherein said radially deformed portions of said shell are defined by circumferentially spaced and circumferentially extending slots in said shell.

6. An electric motor or generator as claimed in claim 2 wherein said radially deformed portion of said shell comprise circumferentially spaced portions bent radially inwardly against the outer surfaces of said end members.

7. An electric motor or generator as claimed in claim 2 wherein said radially deformed portions of said shell comprise circumferentially spaced tabs engaging the outer surface of said end member.

8. An electric motor or generator as claimed in claim 2 wherein said radially deformed portions of said shell comprise isolated longitudinally slit tabs bent radially inwardly against the outer surfaces of said end members.

9. An electric motor or generator as claimed in any of claims 1 to 8 wherein said first mentioned radially extending portions having said abutment surfaces thereon comprise notches circumferentially spaced on the ends

of said shell, the bases of said notches defining accurately formed radial abutment surfaces, said end members having radially extending projections with surfaces abutting said radially extending surfaces.

10. An electric motor or generator as claimed in claims 2 and 9 wherein said radially deformed portions of said shell are defined by slots spaced from the ends of said shell, said radially deformed portions being bent inwardly intermediate the ends thereof against the outer surafces of the end members.

11. An electric motor or generator as claimed in any of claims 1 to 8 wherein said first mentioned radially extending portions having said abutment surfaces thereon comprise portions of said shell spaced from the ends thereof and bent inwardly to define said radially extending surfaces.

12. An electric motor or generator as claimed in claims 2 and 11 wherein said radially deformed portions of said shell comprise circumferentially spaced edge portions of said shell defined by circumferentially spaced slots in said shell and bent intermediate the ends thereof, radially inwardly against the outer surfaces of the end members.

13. An electric motor or generator as claimed in any of claims 1 to 8 wherein said first mentioned radially extending portions having said radial abutment surfaces thereon comprise circumferentially spaced segments defined by circumferentially extending slits in said shell and bent inwardly intermediate their ends.

14. An electric motor or generator as claimed in claim 13 wherein each of said end members has axially extending projections extending into the space between said last mentioned segments and the interior surface of said shell.

15. An electric motor or generator as claimed in any of claims 2 to 8 wherein said radially extending portions having said radial abutment surfaces thereon are defined by circumferentially spaced notches in the periphery of the shell, said end members having radially extending portions engaging the bases of said notches, the radially inwardly deformed portions of said shell extending circumferentially between said notches and comprising portions bent radially inwardly against the outer surfaces of the end members.

16. An electric motor or generator as claimed in claim 15 wherein said radially inwardly bent portions comprise circumferentially spaced tabs engaging the sides of said radially extending portions and the peripheries of the end members.

17. An electric motor or generator as claimed in claim 15 wherein said radially inwardly extending portions comprise spaced pairs of tabs bent inwardly from the periphery of the shell.

18. A method of making a frame or housing for an electric motor or generator which comprises forming a rectangular blank into a cylindrical open ended shell, forming radially extending circumferentially spaced abutment surfaces on said shell at points axially inwardly spaced from the edges of said shell and accurately positioned relative to one another in a direction longitudinally of the shell, forming radially extending counter-surfaces on end members adapted to support the bearings of the motor or generator, bringing the radially extending counter-surfaces of the end members into engagement with the radial abutment surfaces on the shell, and thereafter deforming portions of the edges of said shell radially against the outer surfaces of the end members.

19. A method as claimed in claim 18 in which said last-mentioned portions are formed before they are deformed by providing circumferentially spaced slots in said shell spaced from the edges of said shell to define segments that are thereafter deformed radially inwardly.

20. A method as claimed in claim 18 wherein said first-mentioned radial abutment surfaces are formed by providing notches in the edges of said shell.

21. A method as claimed in claim 18 wherein said first-mentioned radial abutment surfaces are formed by deforming portions of said shell radially inwardly at regions axially spaced from the ends of said shell.

22. A method as claimed in claim 18 wherein said first-mentioned radial abutment surfaces are formed by providing circumferentially spaced pairs of slots adjacent the edges of said shell to define segments, and thereafter deforming said segments radially inwardly to form said first-mentioned radial abutment surfaces.

23. A method as claimed in claim 22 wherein axially extending projections are formed in each of said end members and said projections are inserted between the inner surface of said shell and said segments.

24. A method as claimed in claim 18 wherein said first-mentioned radial abutment surfaces are provided by forming notches in the edges of said shell, said radially deformed portions of said shell comprising the circumferential portions of the edges of said shell between said notches.

25. A method as claimed in claim 18 wherein said first-mentioned radial abutment surfaces are formed by forming notches in the edges of said shell, said radially extending portions comprising tabs bent from the edges of said shell.

26. An electric motor or generator constructed substatially as herein descibed with reference to and as illustrated in Figs. 1 to 6 of the accompanying drawings.

27. An electric motor or generator constructed substantially as herein described with

reference to and as illustrated in Figs. 7 and 8 of the accompanying drawings.

28. An electric motor or generator constructed substantially as herein described with reference to and as illustrated in Figs 9 and 10 of the accompanying drawings.

29. An electric motor or generator constructed substantially as herein described with reference to and as illustrated in Figs 11 to 15 of the accompanying drawings.

30. An electric motor or generator constructed substantially as herein described with reference to and as illustrated in Figs. 16 to 18 of the accompanying drawings.

31. An electric motor or generator constructed substantially as herein described with reference to and as illustrated in Figs 19 and 20 of the accompanying drawings.

32. Methods of making a frame or housing for an electric motor or generator substantially as herein described with reference to the accompanying drawings.

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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1

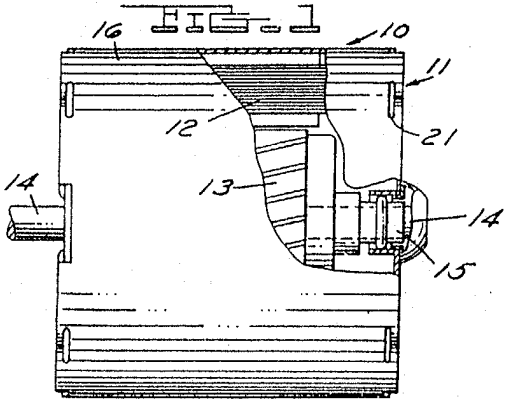

FIG. 3

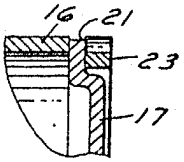

FIG. 2

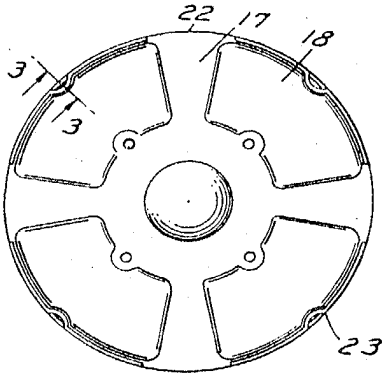

FIG. 4

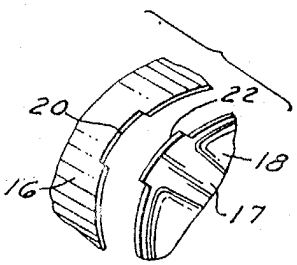

FIG. 5

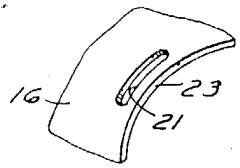

FIG. 6

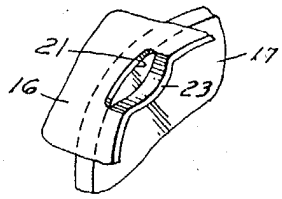

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FIG. 7

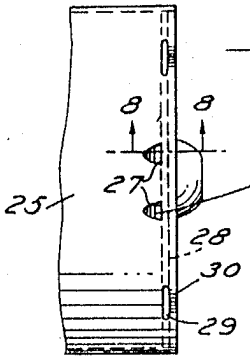


FIG. 8

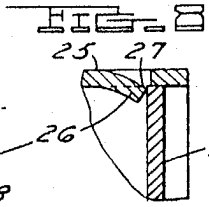


FIG. 9

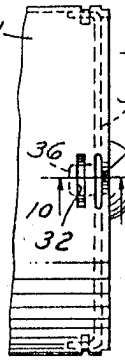


FIG. 10

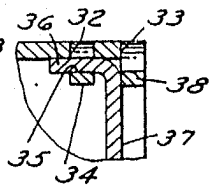


FIG. 11

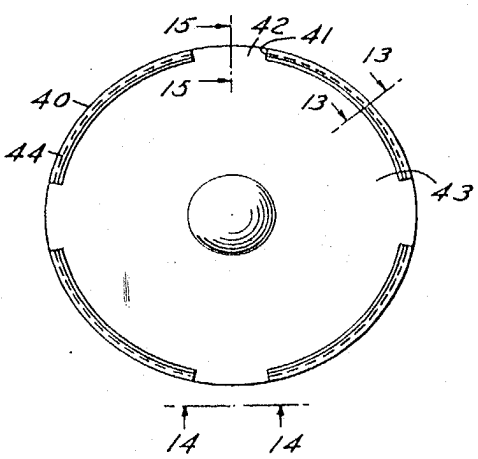


FIG. 12

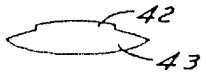


FIG. 13

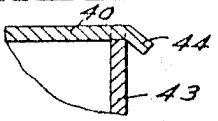


FIG. 14

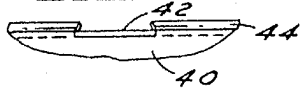
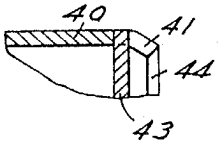


FIG. 15



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Sheet 3

FIG. 16

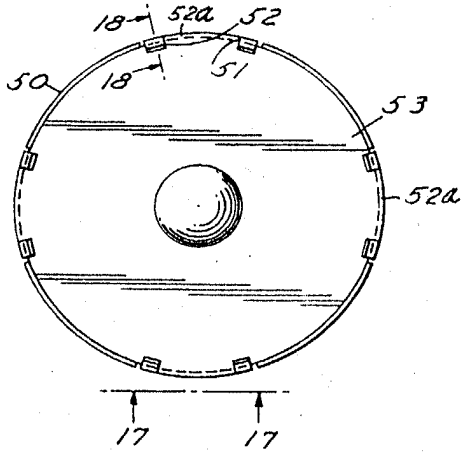

FIG. 17

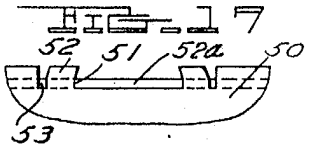

FIG. 18

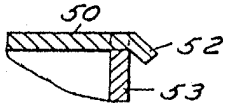

FIG. 19

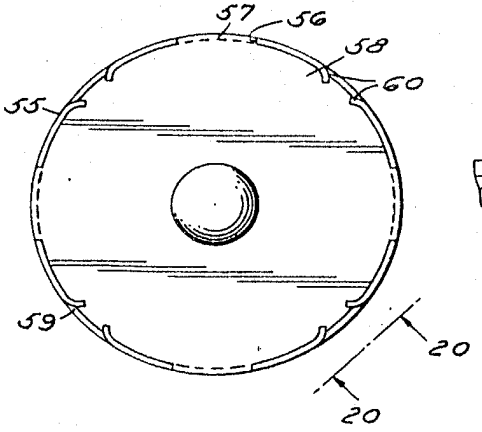

FIG. 20